

Claims

1. A method for monitoring the presence of selected chromophores in a sample of epithelial tissue, independent of the amount of a predetermined chromophore, the method comprising:

5 illuminating an area of tissue by projecting light from a light source of at least two different wavelengths λ_1, λ_2 ;

receiving light remitted by the illuminated area of tissue at a photoreceptor; analysing the received light to obtain a measurement $R_i(\lambda)$ for each wavelength

10 and then calculating :

$$Z = \frac{R_i(\lambda_1)}{R_i(\lambda_2)^l}$$
 where l is chosen such that Z is independent of the amount of predetermined chromophore.

2. A method according to claim 1, in which $R_i(\lambda)$ is calculated by
- 15 analysing the received light to identify and measure the proportion of light of each wavelength remitted from the tissue $I_r(\lambda)$; and calculating the ratio of light at each wavelength returned from the tissue $R_i(\lambda)$.

3. A method according to claim 1 or 2, in which l is calculated such that
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$$Z = \frac{R_d(c, h, \lambda_1)^j}{R_d(c, h, \lambda_2)^{jk}} = \frac{R_i(\lambda_1)^j}{R_i(\lambda_2)^{jk}} = \frac{R_i(\lambda_1)}{R_i(\lambda_2)^l}$$
 where j and k are such that
- $2j\alpha(\lambda_1) = 2kj\alpha(\lambda_2) = 1$ where $\alpha(\lambda_1)$ and $\alpha(\lambda_2)$ are the absorption coefficients for the predetermined chromophore at each wavelength.

4. A method according to any one of the preceding claims, in which the
- 25 predetermined chromophore is melanin.

5. A method according to any one of claims 1 to 4, in which the predetermined chromophore is haemoglobin.

6. A method according to any one of the preceding claims, in which the epithelial tissue is skin.

5 7. A method according to any one of the preceding claims, in which the wavelengths λ_1 , λ_2 are chosen such that a change in collagen level causes a relatively small change in the absorbption of λ_1 , and a relatively large change in the absorbption of λ_2 .

10 8. A method according to claim 7, in which the difference between the two wavelengths λ_1 , λ_2 is at least 200 nm.

9. A method according to claim 8, in which the wavelengths are substantially 700 nm and 940nm respectively.

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10. A method of forming an image of an area of epithelial tissue independent of the amount of a predetermined chromophore in the tissue, locations, formed by obtaining Z for a plurality of locations within the area, Z being obtained by illuminating an area of tissue by projecting light from a light source of at least
20 two different wavelengths λ_1 , λ_2 ;

receiving light remitted by the illuminated area of tissue at a photoreceptor; analysing the received light to analysing the received light to obtain a measurement $R_i(\lambda)$ for each wavelength and then calculating :

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$$Z = \frac{R_i(\lambda_1)}{R_i(\lambda_2)^t}$$
 where t is chosen such that Z is independent of the amount of predetermined chromophore;

and mapping the amounts Z at positions indicative of the location within the area of the measurement.

11. A method according to claim 10, in which $R_r(\lambda)$ is calculated by analysing the received light to identify and measure the proportion of light of each wavelength remitted from the tissue $I_r(\lambda)$; and calculating the ratio of light at each wavelength returned from the tissue $R_r(\lambda)$.

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12. A method according to claim 10 or 11, in which l is calculated such

that $Z = \frac{R_d(c, h, \lambda_1)^j}{R_d(c, h, \lambda_2)^{jk}} = \frac{R_r(\lambda_1)^j}{R_r(\lambda_2)^{jk}} = \frac{R_r(\lambda_1)}{R_r(\lambda_2)^j}$ where j and k are such that

$2j\alpha(\lambda_1) = 2kj\alpha(\lambda_2) = 1$ where $\alpha(\lambda_1)$ and $\alpha(\lambda_2)$ are the absorption coefficients for the predetermined chromophore at each wavelength.

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13. A method according to any one of the preceding claims, in which the at least two sets of calculations

$Z = \frac{R_r(\lambda_1)}{R_r(\lambda_2)^j}$ are carried out, a first calculation with l_1 such that Z is

independent of the amount of a first predetermined chromophore, and a

15 second calculation with l_2 such that Z is independent of the amount of a second predetermined chromophore.

14. A method according to any one of the preceding claims in which the light source used to illuminate the tissue, is of at least three wavelengths,

20 $\lambda_1, \lambda_2, \lambda_3$, and at least three pairs of calculations of Z are made, namely

$Z = \frac{R_r(\lambda_1)}{R_r(\lambda_2)^{l_1}}, Z = \frac{R_r(\lambda_2)}{R_r(\lambda_3)^{l_2}}, Z = \frac{R_r(\lambda_1)}{R_r(\lambda_3)^{l_3}}$, where l_1, l_2, l_3 are each chosen such

that Z is independent of the amount of the predetermined chromophore for the respective pair of wavelengths.

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15. Apparatus for monitoring the presence of selected chromophores in a sample of epithelial tissue, independent of the amount of a predetermined chromophore

comprising a light source for illuminating tissue with light of at least two different wavelengths λ_1, λ_2 ;

a photoreceptor for receiving images remitted by the illuminated area of tissue at a photoreceptor; and

- 5 microprocessor means for analysing the received light to identify and measure the proportion of light of each wavelength remitted from the tissue $I_r(\lambda)$; calculating the ratio of light at each wavelength returned from the tissue $R_r(\lambda)$, and then calculating :

$$Z = \frac{R_r(\lambda_1)}{R_r(\lambda_2)^l} \text{ where } l \text{ is chosen such that } Z \text{ is independent of the amount of}$$

- 10 predetermined chromophore.

16. Apparatus according to claim 15, also comprising image creation means for receiving a plurality of values of Z , each for a specified location on the tissue, and providing a mapped image representing the
- 15 value of Z at the plurality of locations on the tissue.